

# Applying bioeconomy concepts to capitalize on coffee byproducts

Sustainable Agriculture Milestones in the Americas  
Relevant experiences in the region to address climate change and care for the environment and natural resources





## Harnessing the full biological potential of coffee, Latin American farmers are making strides in ensuring environmental sustainability, while increasing and diversifying their income

By harnessing the full biological potential of coffee, Latin American farmers have been able to implement projects that are not only adding value, generating wealth and diversifying income, but also contributing significantly to ensuring the sustainability of an activity that is a key driver of the region's rural economy.

These initiatives are based on the bioeconomy – a system that seeks to fully exploit biological resources and principles in production and industrial processes, and which has been driven by the new frontiers of science, technology, knowledge and innovation. The bioeconomy also provides an alternative to the existing model that has prevailed for decades, namely, the intensive use of fossil fuels, which has created a global climate crisis.

By applying bioeconomy concepts to utilize coffee byproducts and residue, Latin America has succeeded in implementing production, industrial and innovative initiatives that are increasing the economic, social and environmental sustainability of the coffee chain. The chain provides a livelihood for more than 14 million people throughout Central America, as well as in Bolivia, Brazil, Colombia, the Dominican Republic, Ecuador, Jamaica, Mexico,

Panama and Peru. These new biobusinesses, which are generating employment in rural territories that have been hard-hit by the crisis, have converted an environmental problem into a solution, by adding value to residue and waste that were once water and soil pollutants.

The contribution of the bioeconomy is vital for a planet that will have to increase food, energy and fiber production, despite reductions in agricultural land, fewer available natural resources and the need to curb greenhouse gas emissions.

As such, the bioeconomy must be a key component of decarbonization strategies in the economy, thus contributing to achieving the Paris Agreement objective to maintain average global temperature increases below 2 °C vis-à-vis preindustrial levels.

Today, many coffee producing families in Latin America recognize the potential of the bioeconomy to improve their production and processing activities. Increased knowledge of bioproduct markets and support services for biobusinesses will foster greater profitability, competitiveness and environmental sustainability.





## Crisis and opportunity

In Central America, coffee production is an economic activity that has significantly impacted the environment and society. The production chain is extremely important for many families, organizations and businesses and is pivotal to food security, the revitalization of the rural, territorial and national economies, as well as to the capacity of rural territories to generate employment. Thus, making use of coffee residue, by converting it into byproducts, would undoubtedly be important to the region.

At the beginning of the second decade of the 21st century, low international prices and the onslaught of pests and diseases placed farmers in a bind. Since then, the sector has been recovering. However, the crisis also created an opportunity to develop ways to capitalize on the vast economic potential of the coffee chain. Therefore, farmers became involved in new value adding activities.

Less than 5% of the biomass that is generated in the traditional coffee production chain is used to prepare the beverage. The remaining 95% is lignocellulose (leaves, branches and stems obtained during coffee tree renovation); green fruit that falls to the ground during harvesting; fruit removed from the lot during processing; and other residue, including the pulp, mucilage, parchment (husk) and the grounds or dregs that remain after preparing the beverage.



Over the course of the 2018-2019 season, more than one million Central American farmers produced close to 16.4 million one hundred-pound bags of coffee, generating thousands of tons of waste, which represented nearly 80% of the total weight.

The Inter-American Institute for Cooperation on Agriculture (IICA), through its Innovation and Bioeconomy Program, has supported its member countries in designing and implementing bioeconomy strategies, policies and projects to exploit the full potential of the coffee plant in a sustainable and socially inclusive manner.





## The coffee residue bioeconomy

By utilizing coffee byproducts, the bioeconomy is paving the way for productive, industrial and innovative initiatives. Moreover, the biobusinesses and bioenterprises that emerge could support countries' efforts in the area of decarbonization, environmental sustainability and climate resilience.

Close to 75% of the weight of the mature coffee plant is considered residue or waste from the processing or de-pulping of the bean. For example, 100 pounds of coffee berries will produce 18 pounds of green coffee beans (ready for export) and 57 pounds of waste that can be reused as byproducts, including pulp, mucilage and the husk or parchment.

Research is being conducted to reduce to a minimum water use during industrial processes that generate other byproducts, such as the wastewater from processing (coffee effluent).

Moreover, when coffee is being processed for sale, this produces another byproduct: coffee sludge, which in Costa Rica is known as bozorola (the residue remaining after the coffee is infused) and which can be used to prepare organic fertilizer.

According to Rolando Chacón, a representative of the Costa Rica Coffee Institute (ICAFFE), the water content of the pulp must be reduced, which uses a significant amount of energy.

Currently, there are several uses for the pulp: one of them is as organic fertilizer (compost). The residue is subjected to a controlled decomposition process and is converted into a stable product, in terms of moisture and temperature. It is then returned to the field as organic matter. Every 100 pound of pulp produces 10 pound of fertilizer.

In Costa Rica, all of the pulp that was generated during the 2021-2022 harvest was used to make compost. This played an important role in fertilizing agricultural plots, given the crisis affecting the market prices of chemical fertilizers, as a result of the war in Eastern Europe.

The mucilage is employed in the preparation of energy drinks, in the cosmetics industry, for composting and in biofuel products, such as ethanol and biogas. On the other hand, the husk is processed to prepare gluten-free flour and briquettes, used for their aromatic properties and for heating.





## ✓ Success stories in Latin America

Latin America is already harnessing the full potential of the coffee plant, as demonstrated in a variety of success stories in the various countries.

In Brazil, the Guaxupé regional cooperative, (Cooxupé) launched a line of cosmetics, which includes exfoliating products that are made using green coffee oil and pulp. The intention is to export in the near future.

Colombia is another leader in the use of coffee byproducts. For example, the company, Sanadores Ambientales, uses mucilage to produce honey and coffee husk to produce flour. Both products are used for human consumption, as well as in animal production and the cosmetic and pharmaceutical industries.

In Honduras, Los Catadores farm has developed innovative products using the leaves resulting from pruning as well as coffee pulp. It has also developed an array of exotic beverages using dehydrated pulp. In Mexico, students at the Monterrey Institute of Technology and Higher Education (ITESM) developed a bioplastic for the textile and shoe industries. The material was obtained by extracting the pulp from the coffee bean.

Costa Rica's ICAFÉ has pioneered the use of coffee pulp. For more than five years, it has been using pulp to generate energy, make organic fertilizer (compost) and produce pellets. "If producers used 100% of pulp to generate electricity, the drying process would be self-sufficient", explains Rolando Chacón, an official at the institute.

A project involving the production of tea from coffee husks (dry pulp) has garnered attention for its innovation, sustainability and profitability. Implemented in Zarcero, Alajuela, Costa Rica, the project transforms all the dry pulp produced during a harvest (approximately 4,000 kg or 8820 pounds)

into tea, which is subsequently exported to France, the Czech Republic, the United States, Canada, Australia and Japan, where it is used to prepare infusions, energy drinks and carbonated beverages

In turn, Costa Rican cooperative Coopetarrazú utilizes unroasted coffee beans to produce whole coffee and green coffee bean extract pills, which are unique in that they release caffeine more slowly, providing a more prolonged energy supply. They also aid in accelerating metabolism and improving blood circulation. The Cooperative currently converts 98% of pulp into compost, and uses the remaining 2% to produce livestock feed and edible flour that is used to make bread, cookies, cakes and pastries. This flour, which is high in fiber and protein and contains antioxidants and minerals such as iron, can also be used in fruit smoothies.

Coopeagri, another innovative Costa Rican cooperative, uses coffee mucilage to make a natural energy drink called Naox, which contains antioxidants. It is sold in supermarkets in liquid and powdered form. Efforts are currently being undertaken to eventually sell the product in international markets.



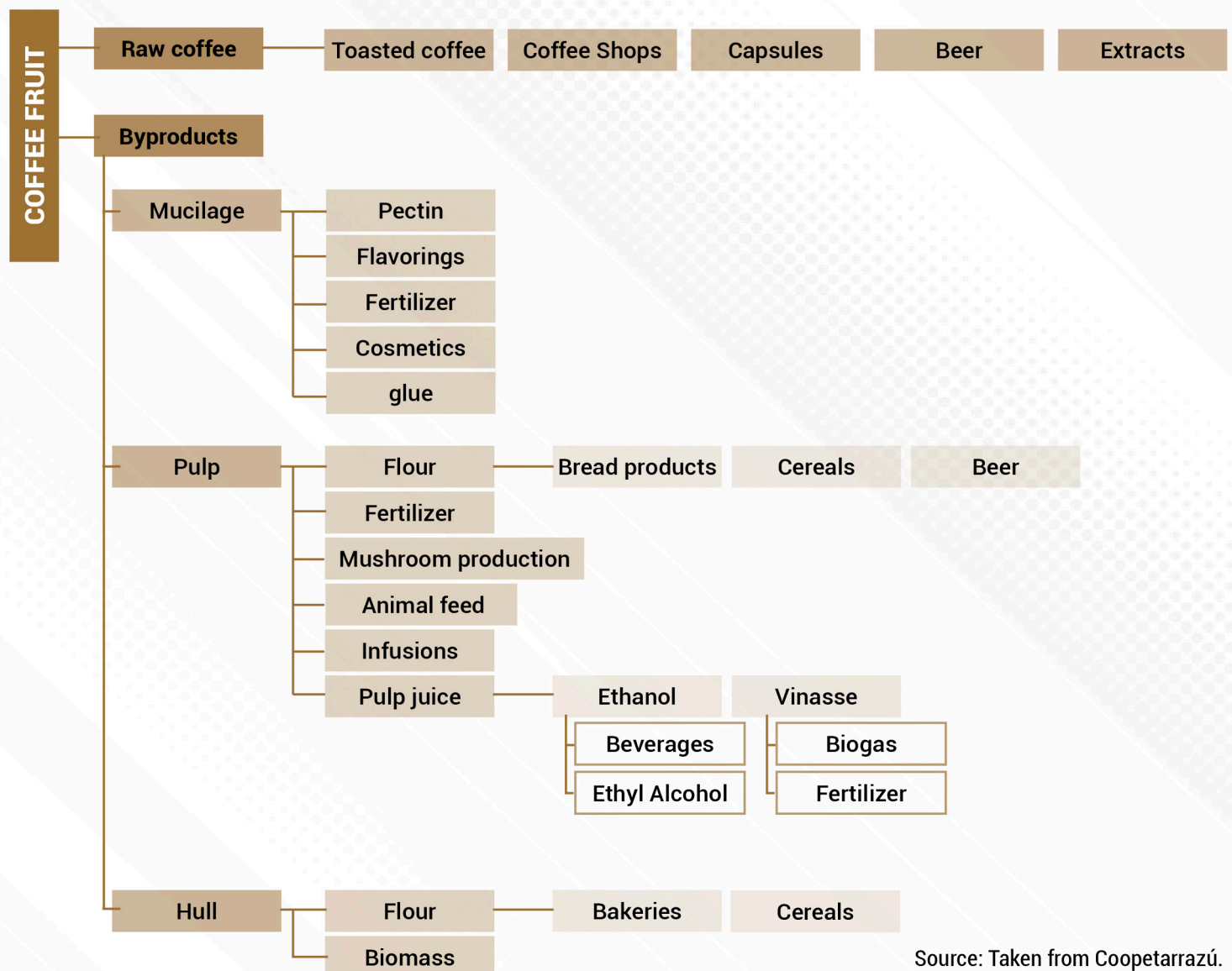


## Fostering entrepreneurship and good practices

Public and private coffee chain stakeholders in Latin America and the Caribbean (LAC) must continue to make progress in discovering and recognizing the potential afforded by the bioeconomy for production and processing activities. This, in turn, will foster more competitive, inclusive and sustainable businesses that capitalize on biological resources and principles in a more efficient and sustainable manner.

“Progress must also be achieved in developing, broadening access to and utilizing bioeconomy technologies and innovations; in strengthening organizational and business capacities; and in developing standards and regulations that not only make new bioeconomy businesses viable, but also ensure that they are established within a framework of sustainability and security”, says Hugo Chavarría, manager of IICA's Innovation and Bioeconomy Program.

## Uses of the coffee byproducts



Source: Taken from Coopetarrazú.



## Challenges and opportunities

Several countries throughout the region lack specific environmental regulations for the chain, as well as technologies, innovations and incentives for capitalizing on residual biomass. This hinders the efficient and sustainable use of biomass through new bioeconomy advances and businesses. In some cases, residual biomass is wasted and even becomes a major source of water and soil pollution.

With a view to supporting new bioeconomy businesses in the coffee chain and other agro-industrial chains in the region, the Institute is working together with several partners to develop a platform for the incubation and promotion of biobusinesses. The platform will connect initiatives to various regional and global institutions that offer support services for ideas and projects aimed at driving the bioeconomy in LAC's agriculture sector and agrifood systems.

Waste and residues—which previously generated environmental issues and high management costs—now represent an opportunity for the coffee industry to improve and diversify its income, reduce its carbon footprint and contribute to mitigating the effects of climate change.



## The bioeconomy and the challenges of the coffee chain

### Challenges

### Opportunities

- Decline in productivity, low yields
- Problems with pests and diseases

- Improved materials: better yields and greater resistance to water stress and pests and diseases
- Greater business efficiency and sustainability.
- Diversified production
- Lower costs and less vulnerability
- Use of the entire product

- Low prices in international markets

- Value adding and differentiation, thereby enabling differential pricing and better market growth prospects
- The use of byproducts that were previously considered to be waste creates new productive and profitable options

- Significant amount of waste and residue that affect the environment

- Generation of bioenergy and bioproducts for the food, cosmetic and chemical industries
- Lower generation of non-usable waste
- Lower volumes of transported products
- Substitution of chemical inputs for use in farming operations (bioinputs)

- Unemployment and migration in coffee regions

- Generation of new job opportunities in rural areas in the new chains
- Generation of job opportunities

Source: IICA.

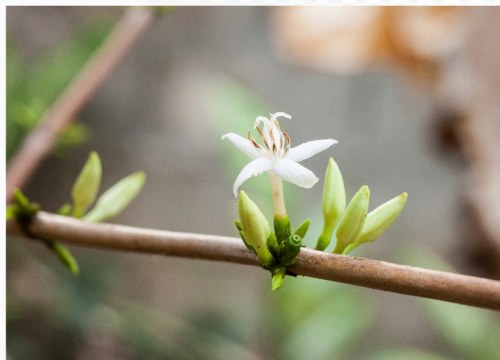


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## Coffee production in Central America (2018-2019)

	Production (100 lb or 46 kg-bags)	Number of producers	Area (ha)	Bags/ha
Honduras	9,558,104.74	120,000	350,000	27
Guatemala	5,226,175.17	125,000	305,000	17
Nicaragua	3,274,277.61	44,519	145,000	23
Costa Rica	1,860,856.7	45,449	84,133	22
El Salvador	976,800	21,704	136,673	7
	<b>20,896,214</b>	<b>356,672</b>	<b>1,020,806</b>	

Source: Prepared based on PROMECAFE and ICAFE.



***"More than 70% of Costa Rica's coffee is produced under adaptation and greenhouse gas mitigation actions." ICAFE.***

***"By means of a network, IICA will seek to attract capital to assess the Central American ecosystem: what is being done, who is doing it and how they are doing it. This network will serve as a bridge, enabling us to work with strategic partners and support the opening of new markets in the region." Hugo Chavarría, IICA.***

***"More than one million Central American farmers produced 33 million 100 lb-bags during the 2018-2019 coffee harvest." IICA.***





## Policies and strategies to foster the bioeconomy and guarantee sustainability



### Awareness raising

Recognizing the economic, social and environmental potential of the bioeconomy



### Regulatory frameworks

Environmental, sanitary, agricultural and health regulations



### Fostering RDI

Innovation programs, clusters, pilot initiatives, generation of enabling technologies, etc.



### Technical/scientific capabilities

Building up the capacity to innovate of professionals and technical/management teams



### Financial and tax incentives

Funding, differentiated taxes, investment funds, assistance, etc.



### Market promotion tools

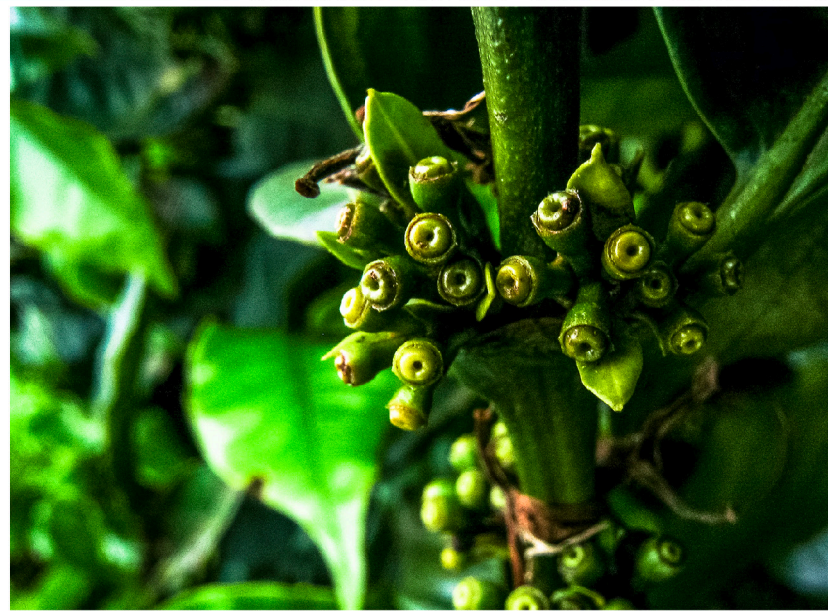
Public procurement, labelling standards, regulations, market transparency



### Industrial localization policies

Fostering clusters, training, FDI, technology transfer, etc.

Source: Hugo Chavarría, Innovation and Bioeconomy Manager IICA



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